IMPROVED OPTIMIZATION METHOD FOR ARRAY FEED CALCULATIONS"

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Array feeds for reflectors have a number of important uses, including 1) generating contour coverage patterns, 2) correction for reflector distortions, and 3) improved wide angle scan. Typical methods for optimizing the array feed for each of these applications are very efficient when a fixed array geometry is utilized and only the feed excitation coefficients are optimized. For this case, only one calculation of the radiating fields from each array element is required. For example, to maximize gain in a given direction, the optimization can be as simple as taking the complex-conjugate of the secondary fields resulting from the illumination of the reflector in the given direction by each of the array feed elements. For most existing methods, an optimization which allowed the element spacing and size to vary would be extremely time consuming since a radiation integral evaluation would be required for each feed element at each step of the optimization process.

A new method of computing array feed performance is presented that obviates the need to recompute the reflector radiation fields when the feed element size or spacing is varied. This allows the optimization techniques to efficiently include size and spacing as parameters.

The mathematical formulation is based upon the use of the Lorentz reciprocity theorem which convolves the focal plane distribution of the reflector system with the feed element aperture field distribution to obtain the element response. Thus the time-consuming reflector system radiation integral evaluation is only done once for a given scan direction for all array feed geometries considered.

Examples using the technique to design an array feed for the correction of gravity-induced distortions of a large dual-shaped ground antenna as well as the design of an array feed for improved wide-angle scan are given.